Watervliet Arsenal Cast-Iron Storehouse
Building No. 38, immediately SW. of the intersection of Westervelt Avenue and Gibson Street, SE. corner of Watervliet Arsenal
Watervliet, Albany County
New York

HAER No. NY-1

PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Office of Archeology and Historic Preservation
National Park Service
U.S. Department of the Interior
Washington, D.C. 20240

HISTORIC AMERICAN ENGINEERING RECORD

WATERVLIET ARSENAL CAST-IRON STOREHOUSE
HAER No. NY-1

Location:	Building No. 38, immediately SW. of the intersection of Westervelt Avenue and Gibson Street, SE. corner of Watervliet Arsenal Watervliet, Albany County, New York Latitude: 42° 43' 00" N. Longitude: 73° 42' 30" W.
Date of Erection:	1859
Fabricator:	Architectural Iron Works, New York, New York: President, James Reed; Superintendent, Daniel D. Badger (in conjunction with designs presented by Major Alfred Mordecai, C.E., the commanding officer).
Present Owner and Occupant:	U.S. Government, Department of the Army, Army Materiel Command
Present Use:	Warehouse and museum of ordnance materiel
Significance:	May well be the only remaining all-iron building still used for its original purpose. It is also an early example of prefabricated construction, all its parts having been constructed by Architectural Iron Works in New York and shipped up the Hudson to be erected on the site.

PART I. HISTORICAL INFORMATION

A. Physical History

In 1813 the United States and Britain were engaged in military skirmishes that later historians document as the War of 1812. One of the problem spots to the Americans was the area around present-day Troy, New York. Expecting an attack from the north at Lake Champlain, or from the west at Niagara Falls, the U.S. Army Ordnance Department (that department of the Army which purchases, manufactures and repairs weapons and ammunition) decided to locate an arsenal in that vicinity. To that purpose the U.S. Government purchased twelve acres of land from James Gibbon and his wife for the sum of $2,585.[1] On the west bank of the Hudson River, the Village of Gibbonsville was directly across the river from Troy. In later years the name of the arsenal (and the surrounding town) was changed to Watervliet (flooding waters) and the installation grew and achieved national attention under that name.

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[1] History of Watervliet Arsenal, 1968.

Perhaps its most significant years of growth began under the leadership of Major Alfred Mordecai, commanding officer from July 1857 to May 1861. A civil engineer and member of the Ordnance Board, Mordecai had been sent by Army Ordnance to an ailing installation and his substantial training and experience proved a great aid in the rehabilitation of the Arsenal. Watervliet, since its beginning, had been subject to floods from the Hudson and the buildings constructed before the Erie Canal were often lower than the level of the Canal, thus increasing flood damage. In addition to the effects of these natural disasters, the Arsenal's commanding officer before Mordecai, Major John Symington, had been ill since 1854, and was unable to devote sufficient attention to the duties of a commanding officer. Thus, Watervliet in 1857 was a disorganized and disoriented installation, badly in need of strong command.

Within two weeks of his arrival, Mordecai was making recommendations for building plans to the Chief of Ordnance. In a letter to Colonel H. K. Craig 10 July 1857 he discussed the need for more "suitable offices."[2] The existing ones were too small and too near the Canal; the spring flood, an annual event, had left its watermark at four and one-half feet that year. He also noted, in the same letter, the need for a storehouse:

> At an arsenal like this, where it is often necessary to expedite large orders for gun carriages which are not to be kept long on hand, what is chiefly required, as a gun carriage store, is a large shed in which the work may be conveniently sheltered as soon as it is turned out of the paint shop and from which it can be easily removed for shipment.

The need for a storehouse was the more pressing to the Arsenal, which had just begun to manufacture Iron Sea Coast Carriages, and Mordecai immediately began to work on plans for its construction. He wanted "to cover a large space with a shed under one roof and one story high (something like a railway depot)..., a shed about 125 feet wide and 250 feet long." Specifying that the warehouse should have room for 300-350 gun carriages, Mordecai also argued that "the floor should be paved with stone and sufficiently raised to secure it from floods and the drainage of the Canal...."

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[2]Letter: Mordecai to Craig, 10 July 1857. 1416-M-494-98. [Entry 1416; Letter-Book "M"; pages 494-98. This notation is used hereafter for citations from National Archives Record Group 156 (see Unpublished Sources of Information).]

Following the common practice of engineers to consult with various builders and contractors, Mordecai apparently discussed his building plans with James Reed, president of Architectural Iron Works (AIW) in New York, in a chance meeting at West Point. Late in October 1857, Mordecai made further overtures to AIW when he sent a sketch of a building to Daniel D. Badger, the foundry's superintendent.[3] With his remarks to Badger, Mordecai enclosed a sketch of the building he needed and invited AIW to submit a design and estimate. He also noted that he wanted a fireproof building and was interested in comparing the costs of iron and brick structures. The initial estimate seemed prohibitive but by 17 December 1857, Mordecai was able to supply Colonel Craig with a drawing from AIW and his own recommendation regarding the storehouse:

> Thinking that it is desirable to adopt in our Arsenal the modern improvements, to make them durable and fireproof, by the extensive use of cast and rolled iron in their construction, I have had a drawing made of an iron building.[4]

The design referred to was submitted by AIW and since the $60,000 estimate attached was higher than Army appropriations promised to be, Mordecai invited other bids the following spring and summer. He suggested that if funds proved insufficient for an adequate storehouse, the Army could construct a simple shed and he invited A. H. Vancleve, of Trenton [New Jersey] Locomotive & Machine Manufacturing Company, to submit a bid for that reduced structure advising that:

> In an unfinished state, as a shed consisting of a roof supported by pillars, it would still be very useful... [and] I would have the parts so made and arranged that the building could at any time be finished according to the plan....[5]

Interestingly, Mordecai added to his demand for a fireproof building, the request that "it also be ornamental. To answer these conditions," he wrote, "I have procured plans and estimates of iron buildings."[6]

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[3]Letter: Mordecai to Badger, 29 October 1857. 1416-M-599.

[4]Letter: Mordecai to Craig, 17 December 1857. 1416-M-642.

[5]Letter: Mordecai to Vancleve, 12 May 1858. 1416-M-721.

[6]Letter: Mordecai to Craig, 14 August 1858. 1416-M-838.

In an effort to "answer these conditions," Mordecai procured many plans and estimates. Though most came from iron foundries, the Major also considered a brick building since it would be cheaper; and he received a plan from Harris & Briggs, of Springfield, Massachusetts, that furnished more store room at a lower cost than the iron proposals.[7] For his final plans, however, Mordecai returned to AIW and on 5 January 1859, he announced to Craig:

> I enclosed herewith a contract with the Architectural Iron Works Company of New York, for building an iron store house at this arsenal.[8]

In the person of James Reed, AIW agreed to build the storehouse on a site to be selected by the commanding officer. The foundation was to be prepared by the Army and the foundry promised to have the building finished "on or before the thirty-first day of August, 1859." It was also subject to inspection by the commanding officer. Because of the expense incurred for materials and casting, before construction could begin, the United States was to pay almost one half of the fee before AIW's builders ever arrived at the site.

Army Ordnance agreed to pay AIW a total sum of $47,360, in several installments. The first $10,000 was due when half of the building parts were completed at the foundry in New York. Upon full completion of iron work at the foundry another $10,000 was due; and the third on its delivery to the Watervliet Arsenal. The remainder was promised upon full erection and satisfactory inspection of the storehouse. "The stipulations with regard to the mode of payment," Mordecai admitted, were "unusual." But he added:

> They appear to me proper, inasmuch as the company must incur a very considerable expense before the opening of navigation [around May 1] permits them to deliver the work at the arsenal, and there is a great gain in the cost of the work as well as in time, by letting it be done during the winter.[9]

Mordecai considered the contractual agreements equitable under the circumstances; but to spare the Army any embarrassment he demanded a $20,000 bond from Reed before they were binding.

By 17 March 1859, half of the work at the foundry was completed;[10] and on 3 May Mordecai wrote to notify Reed that the foundation

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[7]Letter: Mordecai to Craig, 30 October 1858. 1416-M-780-81.

[8]See copy of Contract in ADDENDUM.

[9]Letter: Mordecai to Craig, 5 January 1859. 1416-N-1-2.

[10]Letter: Mordecai to Craig, 17 March 1859. 1416-N-18-19.

would be ready and dry well before June 1. As the building progressed, Mordecai invited other Ordnance officers to inspect the work and on 16 June 1859, the Inspector of Armories and Arsenals, Lt. Colonel James W. Ripley, recorded his approval of it:

> The position, plan and general appearance of this structure meets my approval and it will be at once an ornament to the grounds as well as a valuable addition to the storage room of the Arsenal.[11]

Ripley's comments on the storehouse reveal a satisfaction that was not initially felt by either himself or Mordecai. In the planning and construction of the building, the two men encountered several problems and even clashed over their proposed solutions. When Mordecai first wrote to Craig 10 July 1857 concerning the need for "a shed about 125 feet wide and 250 feet long,"[12] he also specified the exact site on which he wanted to place the structure. Close to the Canal, so as to facilitate shipping, and convenient to the machine shops, where the iron carriages were built, the location was on the southeast corner of the arsenal and already occupied by the Arsenal Laboratory. While he admitted that the removal of the laboratory might raise "objections," Mordecai nevertheless recommended it because the building was "unfortunately placed." Its floor was a good deal below the level of the Canal, resulting in flooding and water damage. Mordecai had no hesitation in replacing a brick building with cracked walls and decayed floors with the storehouse, especially since he proposed to raise the foundation level and thereby avoid flooding. He requested, however, "the benefit of consultation...with some other officer of experience," and Ripley arrived shortly thereafter to survey the situation.

Ripley agreed with Mordecai that the arsenal was badly in need of a warehouse, but he had different views in the matters of size and location.[13] He preferred "a much larger building... say 500 feet long by 200 feet wide" in an area west of the Canal, then occupied by a group of timber sheds; and he specified a fireproof structure. Ripley rejected Mordecai's site because it was on low and damp ground. His own choice, however, posed more of a problem since the carriages to be stored would have to be transported across the Canal (the machine shops being south of the Laboratory) and then up to the level of the timber sheds (to be replaced by the storehouse).

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[11]Letter: Ripley to Craig, 16 June 1859. 1003.

[12]Letter: Mordecai to Craig, 10 July 1857. 1416-M-494-98.

[13]Letter: Ripley to Craig, 9 August 1858. 1003.

The debate over size ultimately was settled by Colonel Craig who preferred the small structure. He argued that:

> The introduction of Iron Sea Coast Carriages will greatly diminish the space required for their storage, whilst they remain on hand, and their indestructibility will enable us to send them to the Forts nearly as fast as made; thus reducing the necessity of large Stores of these carriages at the Arsenals.[14]

In addition to the choice of size, Craig also sided with Mordecai in regard to location, voicing the opinion that "the movement of heavy carriages to and from high ground would be attended with inconvenience and expense."

With the decision to build a relatively small storehouse on the east bank of the Canal, in close proximity to the machine shops, Mordecai once more faced a problem. He now admitted himself reluctant to tear down the laboratory, and instead suggested a site north of the paint shops.[15] Ripley again disapproved "on account of its low and damp situation" and Mordecai admitted that Ripley's objections carried "a good deal of force." The final solution came from an earlier decision of Ripley which was entirely incidental to the plans of the storehouse.

"On the ground adjoining the front of the Arsenal on the south side and facing on the Canal there [was] a lumber yard, on too close proximity to [the] workshops."[16] Ripley proposed to buy the property in the interests of future expansion and permanent improvement. The land was purchased on 7 April 1859, from Albert G. and Harriet D. Sage at a cost of $5,300 and it was here that Mordecai finally decided to locate the storehouse. Little more than 20 feet away from the machine shops, the ground was easily raised to the level of the Canal bank, "above the reach of inundation from the river."[17]

Although the question of size and location caused disagreement between the Ordnance inspector and the commanding officer, both men agreed on the need for a fireproof building and both voiced the hope that it would also be ornamental. The choice of a cast iron structure satisfied both these stipulations. Cast

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[14]Letter: Craig to Mordecai, 7 September 1858. 6-vol. 18-236-67.

[15]Letter: Mordecai to Craig, 24 August 1858. 1416-N-89-92.

[16]Ibid.

[17]Ibid.

iron is made by directly remelting the pig iron that comes from the blast furnace and thus is high in carbon and impurities.[18] Comparatively inexpensive, it is easy to pour into any mold that can be made from founder's sand. It is also "fairly hard and resistant to abrasion and relatively high in compressive strength." Because it is stronger and proportionally lighter than masonry, cast iron is easier to work with than brick. It is also cheaper to erect because the fact that the elements can be factory-produced reduces the need for skilled craftsmen on the job. While it will not withstand much tensile stress, (the presence of carbon graphite flakes makes it brittle), it can be reinforced by wrought iron which has a much greater tensile strength. Moreover, although it will warp and buckle at high temperatures, it will continue to support its load thus making it a perfect choice of material for a warehouse whose contents are more valuable than its own walls.

At any rate, the choice proved satisfactory in the case of the Watervliet Arsenal storehouse. By 22 July 1859, a little more than two months after on-the-site construction had begun, Major Mordecai instructed the E. & D. Bigelow Company to "commence forwarding [flagging] stone for the iron building,"[19] suggesting that the iron workers' job was completed by that date. Finally, on 10 November 1859, Mordecai announced "the flagging was finished yesterday."[20]

The completed storehouse answered all the specifications outlined by Mordecai, and seconded by Colonel Ripley. A long, one-story structure, it was slightly to the south of the workshops where the Iron Sea Coast Carriages were painted. On the east bank of the Canal, it was also downhill from the shops so as to facilitate the transporting of the heavy carriages. Relatively safe from fires, the structure was also secure from flood waters as Mordecai had raised the level of the floor above that of the Canal.

Architectural Iron Works was able to meet its contractual obligations in a matter of six months. Working at the foundry during the inclement winter months, the designers and the molders produced the parts of the structure for later assembly at the Arsenal site. The use of brick would have delayed the process by almost as many months, since all work for a brick structure

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[18]Condit, 1960, pages 280-81.

[19]Letter: Mordecai to E. & D. Bigelow Company, 22 July 1859. 1416-N-76.

[20]Letter: Mordecai to E. & D. Bigelow Company, 10 November 1859. 1416-N-126.

would have had to be executed on the site. In addition to meeting the Major's demands for a fireproof and decorative structure, therefore, the design in cast iron proved more efficient, in terms of time saved.

Mordecai was generally satisfied with the building, as indicated by a letter answering an inquiry from James Reed regarding the warehouse. He wrote: "I have to say that the building which you put up last summer at this Arsenal has, so far, stood very well."[21] The Major registered, in the same letter, a mild complaint that the ventilators had allowed some rain and snow leakage, but for 54 years, the building withstood heavy regional rains. In March 1913, the Hudson River, "exceeding all previous flood records," left a water mark of ten inches on the first floor level of the structure.[22] No major damage was incurred and the building still functions as it was intended. Due to the Arsenal's expansion, however, the cast-iron storehouse is no longer convenient to the manufacturing facilities, and it is now used for dead storage. In addition, some 6,000 square feet of the building have been converted to use as an ordnance museum.

B. Biographical Information

"During the first half of the nineteenth century the United States procured its engineers from three main sources."[23] The first was Europe, site of the first notable technological experiments. The second source was the United States Military Academy, at West Point. Founded in 1802 as a training ground for the Army Corps of Engineers, the institution became a full-fledged military academy after the War of 1812; and, at the same time, its engineering curriculum became strongly influenced by the École Polytechnique (from which it recruited some of its early professors). Because of its superior engineering department, the academy attracted many young men who would not otherwise have chosen the military as a career. The Corps of Engineers became the elite corps of the Army and the one usually chosen by top-ranking graduates. Though many engineers left shortly after fulfilling their required years of service, as many graduates remained in the military and some of the most distinguished civil engineers of the nineteenth century were Army officers.

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[21]Letter: Mordecai to Reed, 22 February 1860. 1416-N-158.

[22]Letter: Commanding Officer, Watervliet Arsenal to Chief of Ordnance, 3 April 1913. General Correspondence.

[23]Rae, 1967, pages 331-32, passim.

The third and largest source of nineteenth century engineers was those self-educated men who received their training on the job. The men who built the Erie Canal, for example: Canvass White, James Geddes, and Benjamin Wright, were local landowners with some training and experience in surveying. Their knowledge of the building craft and their awareness of specific needs to be met combined to provide many remarkably innovative structures.

The iron storehouse at Watervliet Arsenal reflects in many ways the representative skills of America's nineteenth century engineers. An expression of the vernacular in the building arts of the nineteenth century, the warehouse was the product of both the client, Major Alfred Mordecai, and the builder, Daniel D. Badger and Architectural Iron Works.

A client with unusual qualifications, Mordecai (1804-1887) was a graduate of West Point, class of 1823.[24] Appointed to the Academy from his native state of North Carolina, he graduated first in his class and was commissioned second lieutenant, Corps of Engineers, 1 July 1823. A brilliant student, Mordecai became a brilliant ordnance officer, being appointed captain in that department in 1832. In 1855 he was one of three officers sent to study military developments in Europe, especially in the Crimea. Unable to visit the Crimea, the Major nonetheless traveled throughout the rest of Europe and returned to the States with rather detailed impressions of engineering, as well as military, developments.

Appointed commanding officer at Watervliet Arsenal 23 June 1857, Mordecai found the Arsenal in a state of substantial decay. Less than two weeks after his arrival, he recommended changes in the building plans to the Ordnance Department. Among these changes was the request for an iron storehouse.

His familiarity with the uses and properties of iron was based on his engineering background reinforced by his observation of the iron structures, especially railway depots, he had seen on his European tour. It served him well in this case and he was able to specify a building suited to his particular needs.

Less than two years after completion of the cast iron warehouse, civil war was declared. Though Mordecai continued to direct the Arsenal -- so well that it was better prepared for the actual outbreak of war than it had ever been -- his Southern birth incited much animosity and hostility "from various sources" within the Army. On 2 May 1861, he found it necessary to resign from the Army and shortly thereafter he left the country for

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[24]Information on Mordecai: DAB, and History of Watervliet Arsenal, pages 32-37, passim.

Mexico. There he remained until after the war, directing the construction of a railroad running from the Gulf of Mexico to the Pacific Ocean. Returning to the United States in 1867, he worked for twenty years for coal and canal companies controlled by the Pennsylvania Railroad. He died in Philadelphia in 1887.

If Mordecai's excellent credentials were a result of his West Point training, the varied experience and practice of Daniel D. Badger, founder of Architectural Iron Works, point to another representative example of the nineteenth century engineer.[25] Born in Portsmouth, New Hampshire in 1806, Badger began his career as a contractor in Boston in 1829. There he engaged in on-the-job training and advanced his building skills. In 1842 he used iron columns and lintels on the first story of a store building he constructed on Washington Street. Badger refused to identify the building, however, and nothing more is known about it. A year later he bought the patent of Arthur L. Johnson of Baltimore for a rolling iron shutter for use with his iron fronts. The shutter afforded protection to the wide show windows which the new structural material made possible. With success, Badger found Boston too small a market and he moved to New York in 1846. There he built his foundry, Architectural Iron Works, on Duane Street between 13th and 14th Streets.

Badger advertised his product widely and business flourished from 1850 to 1870. Responding to the concept of mass production which was gaining increasing importance in many industrial areas, he employed a standard structural system that adapted nicely to urban building requirements. He repeated this system with no essential change from one structure to another -- consciously imitating the more costly stone architecture of the period. "With his team of anonymous architectural designers, modelers [pattern makers] and molders, [Badger] sought to reproduce...in iron whatever could be produced in stone."[26]

The iron foundry nevertheless produced its own impressive style of urban architecture; and the structural uniformity of most of Badger's commercial buildings makes a general description possible.[27] Most of them were from two to six stories high, the stories ranging in height from nine to fourteen feet; spandrel depth was usually two feet. Column spacing in the facade was usually six feet; and the hollow columns were seldom less than

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[25]Information on Badger: Condit, 1960, passim, and Sturges, 1970, pages vii-ix, passim.

[26]Sturges, 1970, page viii.

[27]Condit, 1960, page 31.

twelve inches in diameter. Interior framing generally consisted of iron columns and timber floor beams.

Illustrations of Iron Architecture (1865) is the catalog of Badger's Architectural Iron Works. In its preparation Badger made many mistakes: inaccuracies in dates, dimensions, and structural detail abound. He did not err in the choice of his lithographers (Sarony, Major & Knapp, New York), however, and the Illustrations are themselves a collected work of art. Nonetheless, Badger's impressive heritage does not lie exclusively on the pages of his catalog. He was a pioneer in the use of prefabricated construction -- of which the Watervliet iron storehouse is an excellent example -- and his exploitation of iron technology anticipated, in a crude fashion, the steel frame of the twentieth century skyscraper. One of many self-trained engineers of that period, Badger's contributions are not unique. They are significant, however, for the technological developments which they represent and for the building skills which they summarize.

Though Badger named his foundry Architectural Iron Works, the basic sameness in structure and obvious derivation of style do not denote any architectural ingenuity. His use of iron, on the other hand, in both facades and framing, reveals an innovative and daring engineering mind; and his buildings enrich engineering history.

ADDENDUM

Washington National Archives, Records of the War Department (R.G.156) Ordnance Contract, Reed, J. M.

Iron Store House, Watervliet Arsenal, 1859, MS
J. M. Reed
President of Architectural Iron Works of New York
Contract for an Iron Store House at Watervliet Arsenal

Articles of Agreement between Major Alfred Mordecai, of the Ordnance Department Commanding Watervliet Arsenal, on behalf of the United States, and Mr. J. M. Reed, on behalf of the Architectural Iron Works of New York for building an Iron Store House at Watervliet Arsenal:

1. The Architectural Iron Works agree to build at Watervliet Arsenal an Iron Store House, conformably to the drawings and specifications signed this day by the contracting parties above mentioned, and deposited with the Commanding Officer of Watervliet Arsenal.

2. The Site for the Said building is to be selected by the Commanding Officer of the Arsenal, and the foundation for

the building are to be prepared by the United States. The Work on the foundation is to be commenced as early in the Spring of the present year as the Season will permit, and to be continued with due diligence, so as not to delay unreasonably the erection of the superstructure, after the materials for the latter shall have been delivered at the Arsenal.

3. The building is to be completed on or before the thirty first day of August 1859.

4. The work on the building is to be subject to inspection, in all its Stages, by the Commanding Officer of Watervliet Arsenal for the time being, and by Such persons as he may appoint for that purpose; and it is to be executed, as regards both Materials & Workmanship, in a Manner satisfactory to the said commanding officer, or the inspector appointed by him, having regard to the drawings and Specifications above referred to.

5. The United States agree to pay to the Architectural Iron Works, for the said building completed according to the foregoing stipulations the sum of forty seven thousand three hundred and sixty dollars, which is to be paid in installments as follows: that is to say: First - The Sum of ten thousand dollars is to be paid on the completion of one half of the iron work of the building at the Company's works in the City of New York. Second: The further sum of ten thousand dollars is to be paid on the completion and reception of the whole of the iron work at the said works in New York. Third: The further sum of ten thousand dollars is to be paid on the delivery of the whole of the iron of the building at Watervliet Arsenal. Fourth: The remainder of the Stipulated price of the work is to be paid on the completion of the building and its acceptance by the Commanding Officer of the Arsenal as aforesaid.

6. The valuation of the work on which the first instalment of ten thousand dollars is to be paid shall be made by the Commanding Officer of Watervliet Arsenal, or by an inspector appointed by him for that purpose.

7. If the money appropriated by Congress and applicable to the construction of the building should not be sufficient for making the final payment of the work on the completion of the building, the party of the Second part shall not be entitled to receive or claim from the United States any interest on the amount of which payment may be deferred until funds are provided for the purpose.

8. No Member of Congress shall be admitted to any share in this Contract or receive any benefit to be derived therefrom.

9. This Contract Shall not be considered in force until the party of the Second part shall have made a Bond to the United States, with good Security, in the Sum of twenty thousand dollars, for the faithful completion of the Work; nor until this contract and the said bond shall have been approved by the Secretary of War.

Done at Watervliet Arsenal the fifth day of January 1859.

Watervliet Arsenal (Signed) Architectural Iron Works
By J. M. Reed, Presdt.
January 5.th 1859
(Signed) A. Mordecai
Major of Ordn.

[Bond Follows]

C. Sources of Information:

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PART II. ARCHITECTURAL INFORMATION

A. General Statement:

1. Architectural character: An eclectic, neo-classically detailed building proportioned for stone, but prefabricated almost entirely of cast- and wrought-iron components in New York City by the Architectural Iron Works. The parts were shipped up the Hudson and assembled by that company on site.

2. Summary description: A rectangular warehouse 100' 0" x 196' 0" containing 16 transverse bays and three longitudinal aisles. In addition to a ground floor, the outer aisles each contain a gallery in the 14 inner bays. The structure, as built, is nearly identical to the one in Badger's catalog, Illustrations of Iron Architecture made by the Architectural Iron Works of the City of New York, 1865, Plates XII and XIII.

3. Condition of fabric: Good to excellent.

B. Structural Description:

1. Foundation: Cut limestone sill over random rubble footings on perimeter. Interior columns have ashlar bases dressed similarly to the sill.

2. Wall construction: Cast-iron panels connected by flathead, counter-sunk machine screws through flanged and lipped surfaces, only the counter-sunk heads appearing on the exterior. The paired cast-iron pilasters, 1/2-inch thick, are part of load-bearing channels that provide stiffening

for the walls and support one end of the gallery roof-trusses on the side walls. Corner pilasters are built up box columns. The fenestrated panels and the rusticated detail between the pilasters, both generally 5/16-inch thick, are non-load-bearing. The walls on end and side elevations are topped, respectively, by horizontal plates forming an asymmetrical "H" section and by a shallow horizontal channel, providing additional longitudinal stability and supporting the gallery-truss ends.

The end wall gables are sheathed with corrugated iron, framed with various structural sections above the top plates of the end walls. The end walls subsequently were stiffened by the addition of welded-steel frames, each composed of two struts spanning between each end column and the wall plate, at cornice level.

3. Structural system: The fourteen 12-foot interior bays and two 14-foot exterior bays are delineated by transverse cast- and wrought-iron Fink trusses over the center aisle and modified Fink trusses and composite beams over the side (gallery) aisles. The center-aisle trusses span about 50 feet, the side-aisle trusses and beams about 25 feet. Both trusses are about 8 feet deep, maximum. Both center and side-aisle trusses share the same colinear top chord. All truss members and purlins are wrought iron except for the cast-iron cruciform compression struts. Turnbuckles allow the tensile stress on the 1-inch-diameter rod of the lower chord to be adjusted. All truss connections are bolted.

Longitudinal stability, in addition to that provided by purlins, perimeter plates, and walls, is provided by shallow channel plates which unite the trusses atop the two rows of interior columns. These plates also provide seats for the center-truss end connections.

The columns that jointly support the center and side-aisle trusses are 28' 6-3/4" high and taper from 10 inches to 6-1/2 inches in diameter. The 16 wood gallery joists, 3-1/4" x 11" at 19 inches on center, are supported by the shorter section of the unique, integrally-webbed, duplex (or siamese) columns on the inside and single columns at the exterior wall. These columns are both 5 inches in diameter.

The composite gallery beams are principally cast iron, containing 22 circular openings in the web. A 2-1/2 inch wrought-iron rod, integral with the bottom flange of each beam, provides the tensile strength. These beams are ± 27 inches deep at mid-span. They are nearly identical to the "tension rod girder no. 273" in Illustrations of Iron Architecture..., Plate LXIII.

The siamese columns and composite beam between the fifth and sixth bays from the north on the east side have been replaced by a steel beam and two steel columns.

C. Architectural Description:

1. Floor plans: The ground floor plan is virtually a single area. The 100' 0" transverse dimension is divided into two 25-foot side aisles and a 50-foot center aisle, and the 196' 0" longitudinal dimension into 16 bays (14, 12' 0" inner bays and 2, 14' 0" outer bays), by two rows of siamese columns. The side aisles each contain a gallery floor the length of the inner 14 bays. As evidenced by the gallery floor-joist brackets on the interior of the end walls, the galleries originally were the full 16 bays in length. It may partially have been the removal of these end-bay gallery sections that necessitated the subsequent stiffening of the end walls with steel braces.

2. Stairways: Cast-iron stairways, one in each corner, lead to the gallery level. In a single run they turn 90° in the lower 5 steps. The risers are perforated with circular openings while the treads contain a grid pattern of quatrefoil and circular openings.

3. Openings:

a. Doors: The gabled, end elevations are divided into eight bays. Nos. 1 and 8 contain windowless cast-iron personnel double doors with coffered surface ornament. These doors are not now operative. Bays no. 3 and 6 contain wider doorways. Originally each had a rolling, iron vehicular door, 8 feet wide, two of which still remain, although inoperative, in the respective westerly bays (for a description of their operation see Mechanical Equipment). The easterly rolling doors have been replaced by double, wood, half-glazed doors with glazed transoms. This door is at grade level on the south elevation and up three steps on the north.

b. Windows: The openings on the side elevations are randomly either glazed or closed with fixed iron plates. From the left, the openings in bays no. 1, 2, 3, 4, 5, 6, 9, and 11, west elevation; and bays no. 5, 7, 9, 10, 11, 13, 14, and 15, east elevation, are glazed, with iron frames and muntins. Each of the remainder is covered with five cast-iron plates, serrated to appear as closed louvers. Originally, the eight windows and eight panels on each side alternated. Windows 1, 2, and 3 of the west elevation are presently boarded. A few windows on the west elevation have been modified to double hung sash. The

end elevations contain windows in bays 2, 4, 5, and 7. The fixed, semicircular-arched, single sashes each contain 30 lights below the semicircular portion. In the semicircular portion the vertical muntins are continued in a circumferential pattern to contain an additional six lights delineated by radial muntins. In each end wall gable is a 7-foot-diameter round window containing circumferential and radial muntins delineating 41 lights. The round windows originally pivoted on horizontal axes for ventilation, but the operating hardware has been removed.

4. Roof:

   a. Shape and covering: Gable roof with a slope of 1:3; corrugated asbestos replaces the original covering.

   b. Eave and entablature: On the side elevations the entablature and coffered eave soffit is comprised of single castings supported by iron brackets bolted to the vertical load-bearing channels of the exterior wall and spaced 6 to 7 feet apart. An unusual angle is attached to the outermost part of the eave. This angle has its horizontal leg formed in a wave pattern with an amplitude of 6 inches. This is the amplitude of the existing corrugated-iron covering of the gables, which is original. Thus it is quite likely that the original roof covering was the same type and size corrugated iron. On the end elevations the cornice only is separately cast and bolted to shorter brackets similarly located and spaced.

   c. Monitors and skylights: Three combination ventilation monitors and skylights are located at approximately the quarter points on the roof ridge. The sides and ends of the monitors (except two ends which have been replaced with blank panels) contain adjustable iron louvers from which the operating hardware has been removed. The roofs of the monitors contain lapped glass pane skylights which replace a corrugated covering, like that formerly on the main roof, since the same wave patterned angle remains attached to the monitor eaves. Each roof slope also contains 4 corrugated fiberglass skylight sections set within the corrugated asbestos roof panels in a horizontal line.

5. Flooring: The concrete ground floor replaces the original stone flagging. A 1-1/8-inch plywood deck has replaced 1-1/8 x 4-inch wood decking on the galleries.

6. Wall finish: The building exterior was painted light grey in 1969, similar to its original color. By 1971 the exterior had been repainted buff. Interior iron surfaces are painted a metallic silver. Interior faces of the wall panels in general reciprocally reflect exterior detailing and decorative features.

7. Notable hardware: Several columns above the gallery level on the west side support pivoting, cast-iron, cantilevered jibs fitted with hoist rope pulleys for raising and lowering material to the gallery level.

8. Mechanical equipment:

   a. Lighting: Originally there was no provision for other than natural light through the alternating glazed openings on the side elevations and the four windows and round window on the end elevations. Additional natural light has been provided by the monitor and roof skylights. Area electric lights have been installed on every third column, aimed to light the center aisle.

   b. Plumbing and heating: No systems incorporated.

   c. Ventilation: Ventilators incorporated into the monitors and round windows have been mentioned above. In addition, the bases of the non-load-bearing window panels on all elevations contain a row of 2-1/4-inch-diameter ventilating holes.

   d. Rolling iron vehicular doors: Operated by original (although inoperative) sprocket pulley, chain, and hand crank. The door is made up of a shutter of horizontal iron slats hinged together. To open, the shutter was reeled around an iron windlass driven by the sprocket pulley on one side, aided by a counterweight suspended from a pulley on the other. This "rolling iron shutter," an early and particularly emphasized Badger product, is similar to the one in Illustrations of Iron Architecture..., Plate XXIX.

D. Site Description:

1. Orientation: N 16°E-S 16°W (with true north) along the longitudinal axis.

2. Setting: Southeast corner of Watervliet Arsenal. Approximately 145 feet tapering to 75 feet east of the filled bed of the former Erie Canal. A (now filled) basin of the former Canal was located about 45 feet north of the building. The

Hudson River parallels the building about 475 feet to the east. A state highway, parallel to the river, passes along the east boundary of the Arsenal about 275 feet east of the building. Brick buildings directly west and across the former Canal site house various machine and gun shops.

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PART III. PROJECT INFORMATION

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